

Intraoral Zygoma Reduction Using L-shaped Osteotomy

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Background: Because of the various defects of malarplasty, including a large incision, much bleeding, visible scars after the operation, and so on, caused by the conventional coronal incision or the temporal incision with the intraoral incision approach, the malarplasty by simple intraoral approach is an innovative development.

Methods: Through the intraoral approach and subperiosteal dissection, we can reach the osteotomy point on the zygomatic body directly and arrive at the osteotomy point at the zygomatic arch end along the medial side of the zygoma. A new L osteotomy is applied with the reciprocating saw. In addition, the osteotomy was performed on the zygomatic arch from the inside out with an angle of 20 degrees horizontally.

Results: From 1997 to 2010, we were satisfied with the results of 114 cases of malarplasty with the intraoral approach and L osteotomy as the observed objects. There are 103 cases for women and 11 for men. Ages ranged from 16 to 48 years. The mean operation time is approximately 1 hour. We just had a few complications: 3 nonunion at the

osteotomy line and needed a second surgery to repair as well as 2 slight cheek drooping during the initial period and required face lifting.

Conclusions: The method of intraoral approach and L-shaped osteotomy for zygoma reduction can reduce prominent zygoma while maintaining the natural curves of the zygomatic body and arch. Because of the simple procedures, fewer complications, and excellent results, this method will be considered a relatively desirable way.

Level of Evidence: Therapeutic, III.

Key Words: Intraoral, approach, osteotomy, protruding, zygoma

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Wide zygomatic bones make a Korean face seem wide and stubborn. It also leads to prominent midfacial lines that give a hard and excessively strong impression. For many Koreans, the oval facial shape is more popular. Therefore, malarplasty is necessary for those with prominent zygoma.

Compared with other facial bones, the shape of the zygoma is relatively complicated and should be balanced in appearance side to side. Considering such a structure, the result after malarplasty tends to be dissatisfying and risky, with possible complications of nerve damage or nonunion of the osteotomy joint, which necessitates a second surgery to adjust.¹ Since 1983, when malarplasty through intraoral approach with burring was reported by Onizuka et al,² various kinds of approaches and surgical methods have been developed, leading to safer methods of reduction and better results. The other approaches except the intraoral approach have obvious disadvantages, which are as follows: too numerous and relatively long incisions, extensive dissection, much bleeding, nerve damage, and conspicuous scars after the surgery. Therefore, malarplasty through the intraoral approach with L-shaped osteotomy can be used to avoid all the previously mentioned disadvantages and adjust the facial imbalance in patients with prominent zygomatic body and arch. In this article, we review 114 cases of zygoma reduction using this method, with satisfying results during the follow-up periods.

PATIENTS AND METHODS

From March 1997 to 2010, a total of 114 cases of malarplasty with L-shaped osteotomy through intraoral approach were performed, including 103 cases for women and 11 cases for men, with ages ranging from 16 to 48 years, all caused by congenital abnormality or heteroplasia.

Preoperative Assessment

Measurement of the ratio between the facial width and the bony facial width was done after full discussion with the patient. The amount of zygoma to be reduced was calculated using routine x-ray films (Water's view, submentovertex view) or facial three-dimensional computed tomographic images. The osteotomy line was drawn on the x-ray films or computed tomographic images. A routine checkup was done and facial pictures were taken (including the frontal



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Seung Eup Hong, MD, PhD: the first author, wrote this article and performed the operative procedure; Si You Liu, MD: the third author, performed evaluation of data; Jeong Tae Kim, MD, PhD: the fourth author, performance of the operative procedure; Jong Hun Lee, MD, PhD: the corresponding author, wrote this article and performed evaluation of data.

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FIGURE 1. Design: The view of L-shaped osteotomy of zygomatic body and the zygomatic arch osteotomy line with an angle of 20 degrees horizontally. The black L marked at the zygomatic body is the osteotomy line. The width of the L is the width of osteotomy, which determines the reduction of the prominent zygoma after the surgery.

view, bilateral profile views, bilateral three-fourth views, and the worm's-eye view) before surgery.

Surgical Technique

Incision was made on the intraoral region with the mucosa being slightly upward; then separation of the periosteum was done. Subperiosteal elevation was done with periosteal elevator at the maxilla anterior wall, the zygomatic body, and the posterior end of the zygomatic arch. Careful attention was paid to the position of the infraorbital foramen so as not to injure the nerves and vessels. The surgical field was fully exposed with a special wire retractor. The osteotomy line was marked with gentian violet (an L-shaped osteotomy 3–5 mm in width). We designed the L-shaped osteotomy line as shown in Figure 1, with the width of the osteotomy line determining the amount of the osteotomy. A part (approximately 1 cm) of masseteric and the zygomaticus major muscles were detached from the inferior border of the zygoma and the zygomatic process of the maxilla to facilitate the approach to the inner side of the zygomatic arch. At this point, care was taken to minimize the detachment of the zygomaticus major and masseter muscle to prevent postoperative cheek drooping. The posterior end was reached following the inner side of the zygoma between the zygomatic arch and the coronoid-temporalis muscle, and approximately 1 cm of the periosteum was dissected from the bone on both the inner and outer sides of osteotomy point. The saw blade was turned to the outer side approaching the zygomatic tubercle to prevent damage to the muscles and vessels at the inner side. Although a blind procedure, the saw blade was stopped when the zygomatic tubercle was reached. During the osteotomy at the zygomatic arch, special attention should be paid to protect the facial nerve at the outer side of the osteotomy point to protect the lateral soft tissue and nerve from accidental injury by the saw blade. The osteotomy was done from the inside out, horizontally within the temporal fossa, with the osteotomy angle being 20 degrees using a reciprocating

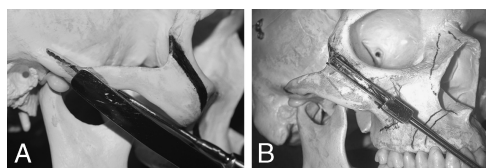


FIGURE 2. A, During the osteotomy from the inside out of the zygomatic arch, the periosteum around the osteotomy line only approximately 1 cm need to be dissected; the isolation should be conducted outside the zygomatic arch to protect the facial nerve in osteotomy. B, Osteotomy on the zygomatic body with the saw blade (3 or 5 mm): make the bone groove as the osteotomy line and then remove the bone with the straight reciprocating saw.

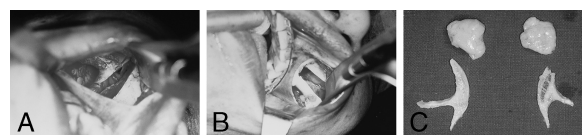


FIGURE 3. A and B, Operative views showing the L-shaped osteotomy area clearly from the incision (after osteotomy). C, Bones that were removed and the cheek fat picked out in the operation.

saw. If the zygomatic arch was extraordinarily wide, the middle portion of the zygomatic arch was notched to cause a greenstick fracture so that the prominent zygomatic arch was corrected. The parallel bone gap was made simultaneously using the specially designed reciprocating saw blade (Double-Bladed Zygoma Reciprocating Saw Blade; Prima, Seoul, Republic of Korea), with 2 saw blades fixed at 3 and 5 mm apart. During the osteotomy, a gauze was put under the zygomatic body to protect the vessels and nerves from damage (Fig. 2).

After the osteotomy, the bone fragments were removed and infracture of the zygomatic arch was done. Protection of the periosteum of the dissociated part and the soft tissues around the osteotomy line was done to avoid bleeding. If the patient had a fatty cheek, a part of the fat pad was removed after full communication with the patients (Fig. 3). Both sides of the osteotomy line were put together to push the dissociated malar inside and upward. Then, the bone segment was fixated using surgical wire after drilling on both sides of the osteotomy line. The stepping deformity under the orbit was shaved with a burr until made smooth. Osteotomy to the contralateral side was done in the same way, and attention was paid to ensure that the height and width of the zygoma were equal after fixation on both sides.

RESULTS

There were a total of 114 patients who received zygoma reduction using this method, and all patients were satisfied with their results. In these cases, 87 cases were bilateral malarplasty with simultaneous bilateral mandible angle reduction, 19 cases were bilateral malarplasty with simultaneous genioplasty, and 8 cases were simple bilateral malarplasty without any other associated operations (Table 1). Seventy-six patients accepted the L osteotomy and removed a 5-mm fragment, whereas 38 patients cut the fragment on 3 mm. All cases were done bilaterally, with the purpose of each surgery being to achieve beauty in all patients. The mean operation time was approximately hour. After the malarplasty, the patients were followed up over 6 months.

In all cases, the wounds healed well without any cases of infections. In 3 cases, nonunion at the osteotomy site was seen because of erroneous pressure on the operation site postoperatively in 2 patients and faulty fixation of the bone segment during the operation in 1 patient. In the patient with faulty fixation of the bone segment, skin shading caused by step-off deformity of the zygomatic body was also seen and needed a second surgery to correct it. In the initial period, 2 patients showed cheek drooping because of the wide subperiosteal dissection, and each underwent a midface lifting. In 4 patients, a slight difficulty in mouth opening was seen immediately after the surgery because the osteotomy was made too near the

TABLE 1. Summary of Patients

Associated Surgery	No. Patients (%)
Total	114 (100)
	Male, 11 (9.64) Female, 103 (90.35)
Genioplasty	19 (16.67)
Mandibular angle reduction	87 (76.32)
Simple malarplasty	8 (7.02)

TABLE 2. Postoperative Complications

Complication	No. Patients (%)	Treatment
L-shaped osteotomy zygoma reduction	114 (100)	
Nonunion on zygomatic body	3 (2.63)	Secondary fixation
Mouth opening restriction	4 (3.5)	None
Injury to facial nerve	0 (0)	None
Mouth corner numbness	1 (0.88)	None
Slight cheek drooping	2 (1.75)	Face lift
Severe cheek drooping with inferior displacement	0 (0)	None
Temporomandibular joint pain	1 (0.88)	Conservative treatment
Infection	0 (0)	None
Hematoma	0 (0)	None

temporomandibular joint, but symptoms improved in 3 or 4 months. One patient complained of temporomandibular joint pain and responded to preventive antibiotics and anti-inflammatory drugs for suspicious capsulitis for 1 week. Only 1 patient had slight under-lip and mouth corner numbness but recovered in 6 months. Most of the patients showed soft tissue sagging immediately after the operation, and the wrinkles were also deepened. This subsided, however, within 3 or 4 months postoperatively because of wound healing and recovery of soft tissue elasticity (Table 2). Older patients, patients who have a very prominent zygoma, and patients with severe soft tissue sagging would benefit from this procedure. Eighteen months of follow-up showed satisfactory treatment results. All the patients recovered well after the surgery (Fig. 4).

Patient 1

A 26-year-old woman with congenital bilateral prominent zygoma underwent surgery under general anesthesia. Osteotomies on the zygomatic body were done using 2 saw blades fixed 5 mm apart. The patient recovered well after the operation without any complications. Both the patient and the doctor were satisfied with the result in the one-and-a-half year of follow-up period (Fig. 5).

Patient 2

A 44-year-old woman with prominent zygomatic bones and mandibular angles accepted the L-shaped osteotomy zygoma reduction. Her overprotruding zygoma was more obvious than the prominent mandibular angle. Osteotomies on the zygoma body were done using 2 saw blades fixed 3 mm apart, and the bone fragments were removed. No serious complications occurred and the zygoma was reduced effectively. The patient was satisfied with the

results, but without the mandibular angle reduction, her prominent mandibular angle makes her facial profile a square shape (Fig. 6).

DISCUSSION

The approaches for zygoma reduction can be simply divided into 2 parts: the external approaches (such as the coronal incision, temporo-preauricular incision, preauricular incision, etc) and the intraoral approach. The external approaches and the intraoral approach both have their own pros and cons.

The external approaches are endowed with good exposure but followed with visible scars, much bleeding and long operation time. Compared with the external approaches, the intraoral approach has no visible scars, little bleeding, and short operation time. It is associated, however, with some problems such as cheek drooping caused by a wide dissection, limited operative exposure in the area of the zygomatic arch, difficult fixation, and the possibility of facial nerve injury. Hence, we need to minimize the periosteal dissection, shorten the operative duration, and provide a postoperative elastic facial dressing to avoid the cheek drooping. The intraoral approach has been widely used as the most common method to reach the zygomatic body. However, to reach the posterior end of the zygomatic arch with the purpose of reducing the scar is not so easy. To overcome this defect, we use the method that reaches the posterior end of the zygomatic arch along the medial side of the arch. Hence, we are able to reach the zygomatic tubercle safely and simply even in a blind procedure without any nerve injury or serious cheek drooping.

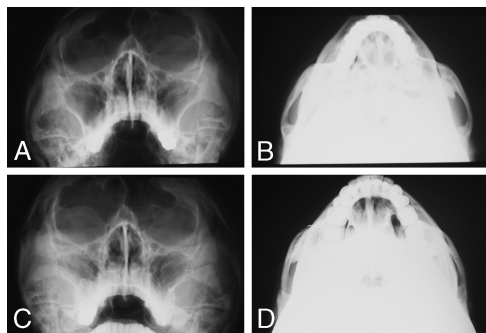


FIGURE 4. Radiologic findings. A and B, Preoperative x-ray films. The prominent zygomatic body and arch can be seen clearly. C and D, Postoperative x-ray films. The zygomatic arch was completely reduced and the bone was moved backward, upward, and inward, which led to the reduction of zygomatic body.

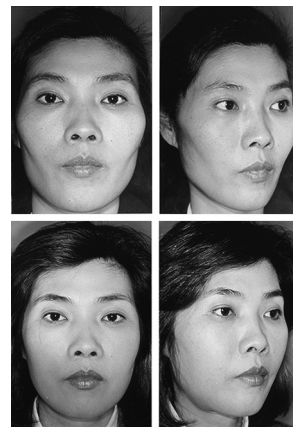


FIGURE 5. A 26-year-old woman for comparison. Above, Preoperative view shows that the woman has a seriously prominent zygoma that makes her cheek obviously hollow. Below, Postoperative view shows that the prominent zygoma is drawn inward and upward after the intraoral approach L-shaped osteotomy for both sides of the malar reduction and that her face looks soft and younger, without deep facial wrinkle caused by the facial drooping. The operation is successful.



FIGURE 6. A 44-year-old woman with prominent zygoma and mandibular angle for comparison. The comparison of her photograph before and after the surgery shows her corrected malar and natural arc from body to arch. Above, Preoperative view. Her overprotruding zygoma is more obvious than the prominent mandibular angle. Below, Postoperative view. The intraoral approach L-shaped osteotomy has been done. Even her prominent zygoma was corrected, without the mandibular angle reduction. Her prominent mandibular angle is extraordinarily obvious to make her facial profile a square shape.

The operating methods for malarplasty can mainly fall into the following: the zygoma reduction method with large burr to thin the zygomatic thickness, the infracture through greenstick fracture, and bone cutting.³

Shaving, however, as a single simple method of zygoma reduction, has not overcome the limitations. If the facial protrusion is only caused by the wide and large zygomatic arch, the zygoma reduction cannot be fully realized only with burring. Furthermore, we cannot avoid the cheek drooping if we use the intraoral approach because of the wide subperiosteal dissection.

The method of infracture is hard to control. We can also see that, if the greenstick fracture is carried out at the arch, the fragments in operation can only be moved to the inside; it is impossible to move backward or upward or downward. To get the best effect from surgery, it is necessary to move the protruding part of the zygoma to the inside, upward, and backward. Therefore, this method is not so satisfactory.

Because of the aforementioned reasons, there is no doubt that the bone cutting method is more effective. The zygoma reduction result of this method depends on the amount of the bone cutting. This facilitates the adjustment of the zygoma reduction and the movement of the fragments so that the best operating effect can be ensured through the best positioning. (The position of the osteotomy line and the moving direction of the protruding malar can be determined during the presurgery assessment.)

There are 2 designs of osteotomy for the zygomatic body: I-shaped osteotomy and L-shaped osteotomy. Baek et al⁴ described an I-shaped osteotomy by removal of the malar complex and contouring of the bone with replacement as a free bone graft. Although it is effective to reduce the facial width, the operation is hard to control and the bone graft has a high possibility to be absorbed. Meanwhile, the shape of the osteotomy line makes it easy for bone fragment displacement and the pulling of the masseter muscle will move the fragment downward. The L-shaped osteotomy can avoid the fragment displacement because the fragment is only removed between 2 L-shaped cuttings but from the inferior border so that, after osteotomy, if we fixate both sides of the osteotomy line, the masseter muscle cannot drag the fragment downward because of the countercheck of the inferior border. That is why we did not have cheek drooping cases in our follow-up period that still can be seen in other's reports.⁵ Another operative method using an intraoral approach has been reported,⁶ but this method also

required extensive subperiosteal dissection from the upper intraoral incision to the posterior area of the arch to approach the lateral aspect of the arch. Theoretically, facial nerve injury is possible during this procedure.⁷ Our method can solve this problem because we do zygoma reduction with L-shaped osteotomy by approaching the arch osteotomy point through the medial side. With our method, we do not require subperiosteal dissection because the osteotomy of the arch is from the inside out within the temporal fossa.

For the zygomatic arch, the most important thing is the osteotomy angle. The different angle leads to a different result. The horizontal cutting angle can only push the fragment inside, and it may cause the result to be less effective. We do osteotomy at the zygomatic arch using a new horizontal osteotomy with the reciprocating saw. Our method provides for the perfect movement of the fragment, making our horizontal osteotomy the most effective method. We can move the fragment backward and inside because we cut the arch horizontally with an angle of 20 degrees.

Another important thing that one needs to pay attention to is the height proportion of the zygoma and the mandibular angle. If the mandibular angle is not wide and large, the malarplasty alone can provide the adjustment to the facial profile; however, if the zygoma is protruding and the mandible angle is prominent simultaneously, the malarplasty alone may lead to a more obvious angle of the mandible.⁷⁻⁹ Therefore, for this kind of patient, the zygoma osteotomy should be synchronized with the mandibular angle reduction to satisfactorily improve the facial profile in one step and avoid the need for a second operation to adjust. Among the 114 cases of malarplasty mentioned previously, 87 of them received simultaneous mandible angle reduction, covering approximately 76 % of all the patients.

CONCLUSIONS

To sum up, using this method of an intraoral approach and L-shaped osteotomy with fixation can protect the nerves from damage during the operation and will leave no scars on the skin or the scalp. Also, especially important is the 20 degrees to horizontal angle from the inside to the outside osteotomy that can make the dissociated bone be easily moved inward and upward. This means the structure can be adjusted on the basis of the patients' unique requirements that can lead to a perfect result after the operation. As a safe and effective method, it can reduce the incision, lower the surgery risk, mitigate patient pain, and shorten the operation time.

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